

# THE WORLD SCANNER REPORT

## A Journal of VHF-UHF Scanner Technology & Engineering

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\$4.00

### SCANNER MODIFICATION HANDBOOK VOL-2 RELEASED

It's been a long time coming but Vol-2 of my Scanner Modification Handbook is now available from the publisher, other mail order firms and directly from me. I think the price is about the same everywhere, but autographed copies are available ONLY from me. Price and ordering information are included in the brochure with this issue and on the blank on Page 7. If you'd like a special greeting or salutation on your autographed copy, just ask. And now let's do a brief summary, though reviews are in this month's "POPULAR COMMUNICATIONS" and MONITORING TIMES magazines. I'm sure Vol-2 will be objectively reviewed in other publications as well, so following is more of a synopsis of the contents than a review. I don't toot my own horn all that well, begging your pardon.

Vol-2 with its 220 pages is 60 pages larger than Vol-1. There's not as many new mods as in Vol-1, but there are more sophisticated ones, more projects and more helpful hints in addition to lots of general information on the science and art of scanning. Now here is a summary of what you'll find in Vol-2:

- + Introduction to modifying your scanner
- + Using a VCR to record scanner action
- + Special techniques for welded PRO-34's
- + Selected troubleshooting procedures for the PRO-2004/5/6
- + Amplifiers for scanners
- + Computer Bulletin Boards and Scanning
- + Official frequency allocations, 25 MHz - 2200 MHz
- + Historical list of scanners; list of over 200 scanners
- + Buying used scanners
- + Trunked radio systems; how the major ones work
- + Alignment instructions for the PRO-2004/5/6; (with basic tools)
- + Build your own fixed +5v and variable DC power supplies
- + More audio output from your handheld scanners (several ways)
- + Telephone Dial Tone Decoder; gives the digits of dial tones!
- + Review & update of Vol-1's modifications; errors, new ideas
- + A great new Analog S-Meter; (really great!)
- + Digital (LED) S-Meters; two types; either is great!
- + Analog & Digital (LED) Center Tuning Meters; shows +1250 Hz!
- + Keyboard Memory Block Controller for MODs 16/19; no switches!
- + Extended Delay, 0-12 sec; you adjust to suit!
- + Add an Event Counter to your scanner; counts # of transmissions!
- + CTCSS Tone Decoders for scanners; (also a "tone finder"!!)
- + Carrier-On-Indicator for scanners; shows Squelch breaks
- + New Automatic Tape Recorder Switch; easier than MOD-6
- + Shielding equipment with plastic cases; stops some RFI
- + Cellular restoration, PRO-2022; easy
- + Speeding up the PRO-2022; easy
- + 3,200 channels for the PRO-2022; just like the PRO-34
- + Speeding up the PRO-34; three approaches
- + Increase the battery power of the BC-100 & 200XLT; several ways
- + Cellular restoration for later BC-200/205XLT; new procedure
- + Speeding up the BC-200/205XLT; double or better
- + Cellular restoration for later BC-760/950XLT; new procedure

Many of the mods in Vol-2 are geared to the PRO-2004/5/6 but can be adapted to other scanners with minimal or varying degrees of difficulty. In the coming months, I will try to show here in the "NSR" how to adapt some of the mods for other scanners. This cannot be done upon request on an individual basis because a lot of expensive R & D is required to tailor a set of procedures for a specific scanner. My books couldn't do that for them all but the "NSR" will try it for the more popular radios, one at a time.

Vol-2 continues with the tradition of exceptional detail on all the projects and mods so that the casual hobbyist will be capable of doing most of them if he/she can read and follow directions. I am still entertained by the comment of a reviewer in the "US SCANNER NEWS" last year who said that my mods in Vol-1 were so hairy that even he, a technician, wouldn't try them. Yet, I have had feedback from some 1,000 lay readers who proclaimed success, if not at first, then shortly thereafter with a little help. That tradition will continue with assurances of my help for little more than the cost of a SASE and a loose extra stamp along with your letter of description and inquiry.

Vol-2 includes updated Cellular Restoration procedures for the newer BC-200/205XLT and BC-760/950XLT rigs. Seems there are two production versions of these units, and each requires a slightly different procedure, depending on the age of the units. When I learned of the production changes, Vol-1 had already gone to press and it was too late to make the changes. This is one reason why the "NSR" was born. You'll always get the latest scoop on any new information that impacts the contents of my books.

There are a few typo errors throughout Vol-2, but nothing as serious as in Vol-1. Thus far, no errors in the technical side of the book have turned up, and are not likely to since I have used the schematics and the book's technical material extensively without problems since writing it last summer. On the whole, I think Vol-2 is a natural shelf-mate for Vol-1, and initial reaction from its readers is exceptionally positive. I'll leave it now to the reviewers and to YOU to judge the merits of Vol-2.

### FROM FIDONET'S COMPUTER BULLETIN BOARDS

**EDITOR'S NOTE:** By and large, I will reprint selected messages from computer bulletin boards without editing them other than to economize on space. For example, the spelling and grammatical errors in the below message are the author's; not mine. Editorial license is a great responsibility and when I quote others' works, their errors will usually be quoted verbatim. Who am I to change someone's meaning? Just be aware that the chatter to be found on the computer bulletin boards is not always authoritative, and more often than not, only represents one writer's opinion. As I quote these messages from time to time, you should draw your own conclusions. The expressed opinions will not always be mine. /BC

- please turn to page 2 -

## ANOTHER OPINION OF AOR SCANNERS

Public Message (Sent)  
Message # 8795 \*SHORT-WAVE\*  
To : Fred Hatfield  
From : Hank Lane  
Subject : ACE AND AOR SCANNERS  
Date : 91/02/25 1:3:00

For anyone's info, here is my story on ACE and AOR. I bought the AR1000 from Grove and rcv'd it on Friday Aug. 31, 1990. Immediate probs were poor sensitivity and birdie obliteration 154-155 MHz. I returned the unit to ACE (Grove doesn't service) on Sat. Sept. 1, 1990 for repairs. I continued to call Ace every couple of weeks for 4 months for updates on repairs. Their standard answer was that they had "not received the documentation" yet to allow the birdie to be fixed. Being fed up, I called ACE on Jan. 10, 1991 and asked for my money back. ACE said "no can do", but they promised to send a new, working AR1000 right away. One week later- still no scanner. I called Bob Grove and explained the whole problem. Although his return policy time period had long since expired, he said he would help to resolve the issue with ACE. To make a long story short, Grove talked with ACE and I finally got my money back; from Grove, not ACE who still has my scanner. Lessons from this; 1) Watch out for AOR handhelds. This is my second reject of one of their units. 2) Watch out for ACE. This is my first direct experience with them (and probably my last). 3) Three cheers for Grove Enterprises. I've dealt with them since their start and have had nothing but outstanding service and products (AOR handhelds excluded) and excellent prices and delivery. 4) I still have \$400-500 to invest for a good all-band scanner.....still waiting for one to appear.  
TBBS v2.1/NM Origin: ANARC BBS (913)345-1978 (280/3)

**EDITOR'S NOTE:** *If and when I encounter good things said about ACE Communications and AOR scanners, I will print them also. Please direct me to any sources of such if you know of any. /BC*

## A NEW HANDHELD SCANNER FROM RADIO SHACK??

Public Message (Sent)  
Message # 4177 \*SHORT-WAVE\*  
To : All  
From : Paul Lukas  
Subject : Realistic PRO-35  
Date : 91/03/25 16:46:00

Here's the specs for the new Realistic PRO-35 scanner:

Channels: 200  
Banks: 10 (20 channels each)  
Scan: 25 channels/second  
Display: 10 digit backlit  
Priority: 1 channel  
Delay: Yes  
Lockout: Yes  
Search: Yes  
Monitor Ch: Yes (10?)  
Dimensions: Same as PRO-34  
Power: 6 "AA" batteries.  
Mem Backup: Capacitor, 1 hour  
Connectors: BNC antenna, earphone, DC power, DC charge

Freq Range: 30- 50 MHz  
108-174 MHz  
220-512 MHz (Military air, AM mode??)  
806-823 MHz  
851-868 MHz  
896-999 MHz

This doesn't look a whole lot different than the PRO-34 (but I'm guessing that we can't enable cellular on this one!).

--- QuickBBS 2.66/0 (Eval)

\*Origin: <MUFONET-BBS Network> Memphis TN: 901-785-4943 (1:123/26)

**EDITOR'S NOTE:** Interesting that the PRO-34 went on sale a few months ago for \$199 and again just this week for \$239. It would then seem that a replacement is on the way. I can't vouch for the above message, but the writer seems to know something. If true, look for the PRO-35 to arrive in late April or early May.

**A READER WRITES....** "My younger brother recently purchased an AOR-1000 handheld scanner. He kept it less than a week. Problems were as follows: very difficult to program and use; had to use the 10 db attenuator with an outdoor antenna. Even in this low population area, it was very susceptible to noise and adjacent frequencies, and had poor quality sound. We both used Uniden Bearcat BC 200 XLTs for comparison. We both feel there is no comparison. The Uniden is the far better scanner. Still the extra frequency range of the AR-1000 is something we both desire. Thought you might appreciate this input." Don L. Engles (Frosty).

**A NIFTY LITTLE TIP..** from a correspondent suggests the use of an LED wired across the terminals of each extension speaker used multi-scanner monitoring station. Seems there might be times when it is difficult to tell from which speaker (and scanner) a given signal is coming. The LED blinking in synchronization with a voice will let you know instantly which speaker and scanner is the source. I was a little concerned about this scheme at first, until I tried it. The volume of the scanner has to be turned up pretty strong to make the LED flash noticeably but it does work without any apparent ill effect. Some LEDs are more sensitive than others, so you might do well to try several types and sizes and select the one that flashes with the least amount of volume. An alternative is to deploy MOD-32, the Carrier On Indicator given in Vol-2 of my Scanner Modification Handbook.

## A POTENT SQUELCH MOD FOR THE PRO-2004 & 2005 (and other scanners) By "PROFESSOR PEABODY"

**EDITOR'S NOTE:** This month "Professor Peabody" takes us into an area of the scanner that is most common in all scanners, the WFM-Osc-Mixer-IF-De-modulator chip. While name, part # and the number of pins of this chip may differ from one scanner to another, they're all essentially the same and they work in the same way. For several years, Radio Shack scanners have used the TK-10420 chip which is what the Professor refers to below. This same chip or an equivalent is used in most other modern scanners so the Professor's Squelch Mod might work in lots of other scanners besides virtually all Realistic scanners. This chip figures into a lot of our modifications, past, present and future, so I am including in this issue some data sheets for the three types of chip in common use. The 16-pin MC-3357 is a spittin'

image of the TK-10420 and the MC-3359 in either the 18-pin or the 20-pin versions, closely resembles the chips used in Uniden and Regency scanners. The main difference among the three is the number of pins; 16, 18 or 20. Just compare the chip's Functional Block Diagrams and the number of pins shown in the Data Sheets on page 6 with the chip data given in your scanner's Service Manual, and then apply the below information:

Greetings Fellow Hackers: This month I would like to turn you on to a mod that was inspired by your humble editor of "WORLD SCANNER REPORT" in V1N2. Bill Cheek discovered that the Radio Shack Pro-2006 has a new electronic switch in the Squelch circuit of IC2, the TK-10420 chip. This is a CMOS switch chip (IC-10) wired in series with R-152 (33k) between pins 12 and 14 of IC2. Owners of the PRO-2004 and PRO-2005, which use the same NFM chip, can refer to the PRO-2006 Service Manual if details of this new circuit are needed. You PRO-2006 owners just sit tight this month since we're going to make other scanners more like yours.

The standard "Squelch Mod" (MOD-4) for the PRO-2004, 2005 and many other scanners has been to either remove the Squelch-Mute resistor altogether or add more resistance between the SQUELCH and MUTE pins of the NFM-Osc-Mixer-IF-Demodulator chip; usually a TK-10420 but which also can be an MC-3361, MC-3359, MC-3357 or either an NJM-3359D-A or TK-10421 in Uniden scanners. This mod allows a tighter squelch action to open and close the receiver audio circuits. As some of you have experienced, it works but it seems to always needs adjustment depending on how noisy the airwaves are. Sometimes a tight squelch works quite nicely. Other times a loose or original Squelch action is required so the radio doesn't drop out on every atmospheric burp. A near-perfect Squelch action was discovered with an unheralded new change in the PRO-2006.

The new electronic switch, easily added to many scanners, actually combines the desired tight squelch to trigger on weak signals, but switches in a resistor (22k-47k) to loosen the Squelch for when signals are present to stop the chopping of the audio that might happen on weak signals. I installed a circuit similar to the PRO-2006's in my PRO-2005 by using one section of a 74HC4066 quad bilateral switch. The more common CD-4066 can also be used to perform this bit of Squelch magic. Either of these 4066 chips have four switches on the chip and we need only one, so three "spares" will be available for other projects sometime. See the schematic elsewhere in this issue for the gory details.

A control pin of the 4066 chip should be connected to the receiver's "MUTE" function pin at the CPU/microprocessor. One lead of the stock resistor between the Squelch and Mute pins of the TK-10420 (or equiv) chip is cut, and the two loose leads are then wired to the Input & Output pins of the new 4066 chip (which doesn't matter). Two other wires to/from the 4066 chip are required; one to ground and one to the scanner's +5v. That's the extent of the necessary effort. External controls not required.

NOTE: I will refer to two different MUTE pins in this article; one is the MUTE pin on the CPU/microprocessor chip, and the other is the Audio Mute pin on the NFM--Osc-Mixer-IF-Demodulator chip, which is the main subject chip of this article. Don't confuse the two "Mutes". They're different pins on two different chips, ok?

When the scanner is scanning or searching, the MUTE signal at the CPU/microprocessor is low or zero volts and turns the 4066 switch off which puts an infinite impedance between the TK-10420 (or equiv) chip's Squelch and Mute pins 12 & 14. This gives the desired "tight" Squelch action for weak signals. Now when the receiver senses a signal and unsquelches, the CPU's MUTE signal goes high at about +5 volts or so. This turns the 4066 switch ON which connects the stock resistor back in circuit to loosen the Squelch so that it doesn't release before it is supposed to. I hope I'm not boring you with too much detail but the operation has to be explained in order to check for proper operation.

I have installed this "new" squelch mod and tested it for a week now. I like it much better than the original Squelch Mod. I get the same triggering sensitivity as before but without the chopping that drove me crazy. I even removed the 100K pot used for the original MOD-4 adjustment of the Squelch action and used the hole for another mod. So, now the squelch action is automatic and neat. Of course, if you still like the original Mod you can insert or keep a 100k-200k pot in series with the resistor and the 4066 switch and have it both ways. Try it and see if you like it. The guys who own a PRO-2006 probably didn't realize anything was different but the PRO-2004, PRO-2005 and other scanners will see a substantial difference in the Squelch action, for the better!

Here's a table that shows the different types of chips and associated resistors to clip for the installation of the new Squelch Mod in different scanners:

SCANNER	CHIP Ckt SYM	CHIP No.	RESISTOR	COMMENTS
PRO-2005	IC-2	TK-10420	R-152 (33k)	
PRO-2004	IC-2	TK-10420	R-148 (47k)	
PRO-2003	IC-104	MC-3357P	R-222 (22k)	
PRO-2002	IC-101	MC-3357P	R-197 (47k)	
PRO-2024	IC-2	MC-3361N	R-76 (33k)	Similar to MC-3357
PRO-2022	IC-1	MC-3361N	R-91 (33k)	Similar to MC-3357
PRO-2021	IC-2	TK-10420	R-64 (27k)	
PRO-2020	IC-101	MC-3357P	R-199 (39k)	
PRO-34	IC-101	TK-10420	R-162 (27k)	
PRO-32	IC-101	TK-10420	R-163 (27k)	
PRO-31	IC-1	TK-10420	R-46 (22k)	
BC-200/205	IC-401	TK-10421M-2	none	See Notes & 1
BC-400/560	IC-1	NJM-3359D-A	none	See Notes & 2
BC-760/950	IC-2	NJM-3359D-A	none	See Notes & 3

NOTES: Recent Bearcat scanners are a little different from the Realistics, and we don't know if the above Squelch Modification will perform the intended purpose. This is largely because the Audio Mute pin on the NFM chip is not used in the Bearcats. This means that there is a full-time high impedance between the Squelch Input pin and the Audio Mute pin. It should be not be difficult to install the 4066 Squelch Switch contacts and a series resistor between the unused Audio Mute pin and the Squelch Input pin. Refer to the specific notes below:

1. BC-200/205 and Regency R-4030: Pins 15 and 17 are the pertinent pins, with 17 not used. The control pin of the 4066 switch should go to the CPU, IC-201, Mute pin 58, or either



side of R-241, whichever is most convenient. The Input pin of the 4066 switch can go directly to IC-401, Pin 17, and the Output pin of the 4066 to IC-401, Pin 15. Pin 15 here is the same point as the high sides of C-411 and R-411 if either of these would be more convenient.

2. BC-400/560: Pins 14 and 16 are the pertinent pins, with 16 not used. The control pin of the 4066 switch should go to the CPU, IC-201, Mute pin 26, or either side of R-217, whichever is most convenient. The Input pin of the 4066 switch can go directly to IC-1, Pin 16, and the Output pin of the 4066 to IC-1, Pin 14. Pin 14 here is the same point as the high sides of C-23 and R-24 if either of these would be more convenient.

3. BC-760/950 and Regency R-1600: Pins 14 and 16 are the pertinent pins, with 16 not used. The control pin of the 4066 switch should go to the CPU, IC-14, Mute pin 2, or to the anode of D-15, whichever is most convenient. The Input pin of the 4066 switch can go directly to IC-2, Pin 16, and the Output pin of the 4066 to IC-2, Pin 14. Pin 14 here is the same point as the junction of R-39 & R-40 or the high side of R-58 if any of these would be more convenient.

**EDITOR'S NOTE:** If you want to try this Squelch Switch Mod to a scanner not listed above, I'll be glad to identify all the necessary chips, pin numbers and connection points for you if you'll send me a clean, clear, complete copy of the Service Manual for that scanner. Sorry, but if no manual, no can help.

I performed the above mod to my PRO-2004 after the "Professor" hounded and goaded me into it. The results are subtle, but quite effective. All the above Realistic scanners will profit from this simple, but capable mod. I can't vouch yet for the Bearcats and other scanners, but your input will be appreciated so I can pass it along to others. Now see the Data Sheet and short article about the NFM-Osc-Mixer-IF-Demodulator chip that is used in so many scanners and other FM radios: ham, CB, commercial, and home. This chip is worth getting to know because what can be done to one of these chips can be done to most! /BC

#### MEMORY UPGRADES FOR THE BC-590XLT, BC-760/950XLT & REGENCY R-1600

I was poring over the schematic diagram of the BC-760/950XLT the other day when I noticed that the static random access memory chip is identical, pin for pin, in function to the memory chips used in the PRO-2004/5/6, the PRO-34 and the PRO-2022. How wonderful for you Bearcat fanatics! Your BC-760/950XLT (or Regency R-1600) comes stock with a paltry 100 channels, but it's virtually certain that you can add another 1,500 by following the general guidelines for MODs 16, 19 and 37 in my Scanner Modification Handbooks. I have not performed this mod to a Bearcat yet, but I was talking to a fellow recently who said that he has done it to the BC-760/950 and also to the BC-590XLT. Stands to reason since the memory chips appear to be compatible with those in the Realistic scanners where huge memory upgrades are old hat now. My examination of several service manuals and conversations with others now strongly suggests that at least the above scanners can be upgraded to 16-times the stock memory by the very same techniques we used for MODs 16, 19 & 37. You'll end up with sixteen Blocks of 100

channels each! You could live with that, now couldn't you? The technique for this is simply removing the stock memory chip and replacing it with a larger 32k x 8 SRAM, typically the Hitachi HM62256LP-12 or equivalent. The stock memory chip has 24 pins and our new one has 28 pins, so it will not fit onto the original pads. No problem; just build your new memory chip into a small perf board; mount it somewhere nearby and wire its pins to the original pads in accordance with the instructions and diagrams given in MODs 16, 19 & 37. In fact, you will build your Extended Memory Board exactly like that pictured on page 131 in Vol-1 of my book. Wiring to the stock memory chip's pads will be exactly as pictured, as well! Feeling bold? Go for the gusto then!

#### MEMORY UPGRADES FOR THE PRO-2021 AND PRO-32

While we're on the subject of memory upgrades, it occurred to me to mention that my MODs 16, 19 & 37 are directly applicable to the PRO-2021 and the PRO-32, if you're so inclined and happen to feel that 200-channels are not enough. If you want to perform the memory upgrade to either of these scanners, just read the general instructions for MODs 16, 19 & 37 in my books, and follow the diagram on page 131 in Vol-1. You'll end up with 3,200 channels organized into 16 Blocks of 200-channels each. No sweat!

#### MEMORY UPGRADES FOR OTHER SCANNERS ?

In the case of the BC-200/205XLT and the Regency R-4030, I'm afraid you're "stuck" with 200 channels. Seems that the UC-1147 CPU has the necessary large chunk of memory on board and we don't dare diddle around with that. There is no external memory chip in this unit for us to hack, cut and chop into mega-memory.

The foregoing is also true for the BC-560/400XLT. Memory appears to be jammed on board the CPU where we can't liberate any more. Other examples in this category are the PRO-2024 and PRO-31

It may or may not be possible to pump up the memory of other scanners, but what's the use? Most ten and twenty channel scanners have their memories right on board the CPU where we can't monkey around, or in cases where there is an external memory chip, the CPU will still address only 10 or 20 channels at a time, so the most you'd come up with is maybe 160-320 channels scattered out over sixteen individually addressable Blocks. This is unwieldy and a poor return for the investment of labor, time and money. In general, it is best to hack the memories only in scanners with 50 or more stock channels, and then only if the memory chip is an external static RAM. Unfortunately, even some of these don't lend themselves to memory expansion including the PRO-2003, PRO-2002 and PRO-2020.

I don't have the Service Manuals in my files to evaluate all the current crop of scanners on the market, but if your scanner is not mentioned in this memory article, and if you are determined to get some more memory out of it, send me a clean, clear, complete copy of the Service Manual for that scanner. I'll evaluate it for what might can be done. Sorry, but if no manual, no can help. If you want or need a service manual for your scanner, refer to VIN2P6 (Feb, 1991, page 6) for the sources. There's no excuse to not have the technical manual for your scanner unless it's a boat anchor out of the past.



NEW ACCESSORY FOR  
UNIDEN BC-200/205XLT & BC-100XLT

METROWEST'S P-120 RECHARGER FOR PRO PACK 1200

Vol-2 of my Scanner Modification Handbook, I wrote about the new MetroWest PRO PACK 1200 heavy duty NiCad battery pack for the Uniden BC-200/205XLT and BC-100XLT Handheld scanners. The PRO PACK 1200 literally doubles the operation time of these scanners between recharges and it looks exactly like the standard battery pack. I tested the PRO PACK 1200 under different conditions and determined that it did everything it was supposed to do, equal to or better than MetroWest's specifications. Not bad!

MetroWest has now introduced the P-120, a special charging stand for the PRO PACK 1200, and do I ever mean SPECIAL! This one is really slick from appearances right into the nitty gritty of how it works and what it does! First, the looks:

The P-120 Recharger vaguely resembles a professional two-way handheld charger, but frankly, I've not seen any pro rigs that look this good! Finished in crinkle black, the P-120 is built with some solid engineering for the physics of gravity! It is bottom heavy to give stability; a sloped cradle allows the scanner to solidly rest for recharging and still allow the operator full access to the front panel controls. A 110 VAC power cord unobtrusively enters the rear of the P-120; and there are two buttons and an LED on the lower front panel. The appearances and operating controls of the P-120 are pleasant and simple, but what a powerhouse in operation!

Basically, the P-120 Recharger has three functions: (1) to provide a quick, full recharge of the PRO PACK 1200, in five hours or less; (2) To provide a safe trickle charge after full recharge to maintain the PRO PACK 1200 at peak power for use at any time; and (3) to deep discharge the PRO PACK 1200 periodically to prevent a "memory" effect from developing in the NiCad batteries.

Embedded into all three functions is a microprocessor that keeps track of what the battery pack needs at any given time. Your PRO PACK 1200 will never be overcharged or undercharged by the P-120! Operation is simple, and largely hands-off. Just drop the scanner into the P-120 stand and if the main power switch is ON, the microprocessor will take a look at things and immediately provide full recharge current if needed; or if not, then a trickle charge. When recharging at the full rate the LED flashes green at a rate of about three flashes per second. When the battery pack becomes fully charged, the microprocessor shuts things down to a trickle and the LED will glow a steady green.

Other than the ON/OFF switch, the only other operator control is the second button for DEEP DISCHARGE. When it is pushed, charging is suspended and the battery pack is allowed to discharge at a rate of about 200-ma for approximately six hours. When the battery pack is discharging, the LED glows a steady red. After the pack has been discharged to a deep, but safe level, the microprocessor turns off the DISCHARGE cycle and immediately starts a full recharge. About five hours later, the P-120 will auto-cycle back to trickle charge. That's it; nothing could be simpler!

As long as the P-120 is left turned ON, the scanner can be dropped into or removed from the stand at any time. The microprocessor senses any charge requirements and makes the correct decision at all times. The only absolute operator requirements are to turn the P-120 ON and to press the DEEP DISCHARGE button, if and when desired. Everything else is automatic.

I did something to my P-120 Recharger that you should NOT do to yours: disassembled it for a curious look inside. WOW! Nothing hokey or low rent under the covers, either! A very professional appearing printed circuit board was loaded to the gills with three integrated circuits, two transistors, two relays, three diodes, transformer, +5v regulator, a hefty handful of resistors and capacitors. There are only two things inside that might interest the hobbyist: a trimmer potentiometer for adjustment of the exact DEEP DISCHARGE point and a 1-amp fuse that's not likely to ever blow. Hobbyists are always interested in things that can be tweaked, but the trim pot is already factory adjusted to the exact, precise point, and does not deserve further attention. The fuse can be replaced if necessary, but if it blows once, the replacement will probably blow, too. So to preserve the excellent warranty, it's best to stay out of the innards of the P-120.

Some readers don't want to hear all about the good sides of a product; they demand to be exposed to the "seamy" side as well. Ok, I found only one bad thing about the P-120: it's designed solely and strictly for the PRO PACK 1200 heavy duty battery pack. You can't recharge standard "AA" or other NiCad cells with the P-120 or, if you do, trouble may settle about your head and shoulders. MetroWest offers other rechargers, though, so the bad side of the P-120 is only a restriction. What doesn't have 'em?

Since this is a "hacker's newsletter", I suppose that you die-hard hackers might as well know that the P-120 will recharge six cells of the oversize "AA" class provided that the rating is 1200 ma/H. I'm talking about the rather uncommon NiCad cell that's the same length as the standard "AA" but about 1/8" larger in diameter. I don't remember what they're called right off, but if your hacker's battery pack uses six of them in series, the P-120 is probably the ticket for you. Just write off any warranties if the P-120 is used for anything but the PRO PACK 1200.

MetroWest offers a double guarantee on the P-120: (1) satisfaction for 30-days or money back; and (2) 1-year guarantee against defect with standard caveats and disclaimers. Contact MetroWest for their catalog or other information as follows: 822 N. Spring; LaGrange Park, IL 60525; (708) 354-2124.

NEW DISCOVERY ABOUT NiCAD CELLS ?

This little tidbit is offered more to entice some authoritative information from you readers than to offer information. I recently read an article in a trade magazine, maybe the "NASA Technical Journal", about a discovery pertaining to NiCad cells. Seems that NASA commissioned Gates and one other manufacturer of NiCad cells to perform independent studies on the well known "memory" effects of partially charged and discharged cells. Apparently, NASA was concerned about longevity and power density

(please turn to page 8)

*SIMILAR TO NFM CHIPS USED IN  
UNIDEN REGENCY SCANNERS*

**LOW POWER NARROWBAND FM IF**

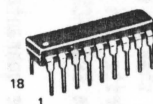
... includes oscillator, mixer, limiting amplifier, AFC, quadrature discriminator, op/amp, squelch, scan control, and mute switch. The MC3359 is designed to detect narrowband FM signals using a 455 kHz ceramic filter for use in FM dual conversion communications equipment. The MC3359 is similar to the MC3357 except that the MC3359 has an additional limiting IF stage, an AFC output, and an opposite polarity Broadcast Detector. The MC3359 also requires fewer external parts.

- Low Drain Current: 3.6 mA (Typ) @  $V_{CC} = 6.0$  Vdc
- Excellent Sensitivity: Input Limiting Voltage —  
-3.0 dB = 2.0  $\mu$ V (Typ)
- Low Number of External Parts Required

**MC3359**

**HIGH GAIN  
LOW POWER  
FM IF**

**SILICON MONOLITHIC  
INTEGRATED CIRCUIT**

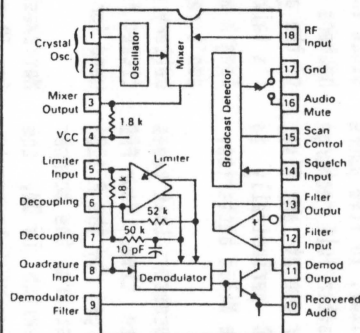


**P SUFFIX  
PLASTIC PACKAGE  
CASE 707-02**

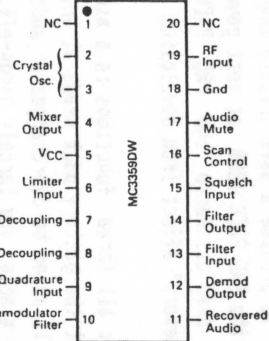
**DW SUFFIX  
PLASTIC PACKAGE  
CASE 751D-03**



**FIGURE 2 — PIN CONNECTIONS AND  
FUNCTIONAL BLOCK DIAGRAM**



**NORMAL 18-PIN VERSION**



**SPECIAL 20-PIN VERSION  
FOR SURFACE MOUNT**

*SIMILAR TO TK-10420 AND OTHER  
NFM CHIPS IN REALISTIC SCANNERS*

**LOW POWER NARROW BAND FM IF**

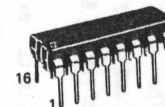
... includes Oscillator, Mixer, Limiting Amplifier, Quadrature Discriminator, Active Filter, Squelch, Scan Control, and Mute Switch. The MC3357 is designed for use in FM dual conversion communications equipment.

- Low Drain Current (3.0 mA (Typ) @  $V_{CC} = 6.0$  Vdc)
- Excellent Sensitivity: Input Limiting Voltage —  
(-3.0 dB) = 5.0  $\mu$ V (Typ)
- Low Number of External Parts Required

**MC3357**

**LOW POWER  
FM IF**

**SILICON MONOLITHIC  
INTEGRATED CIRCUIT**

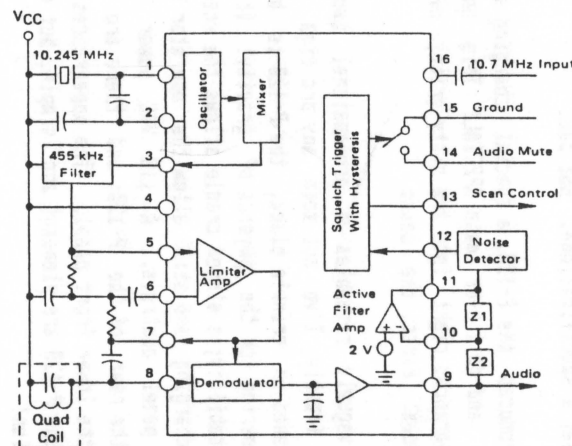


**P SUFFIX  
PLASTIC PACKAGE  
CASE 648-08**

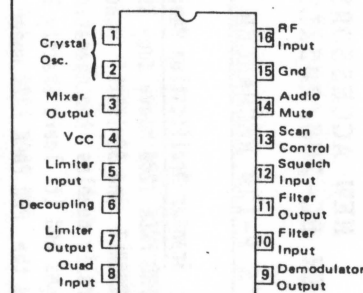


**D SUFFIX  
PLASTIC PACKAGE  
CASE 751B-03  
SO-16**

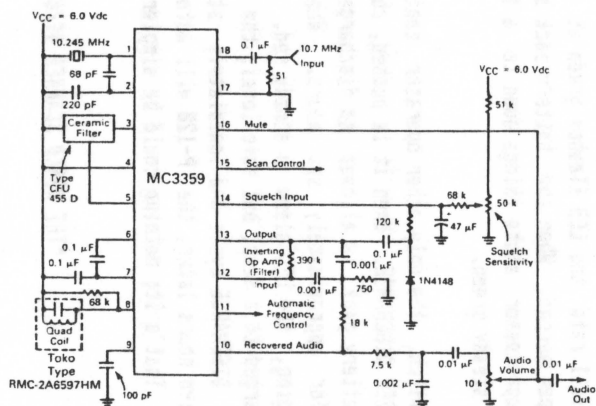
**FIGURE 1 — FUNCTIONAL BLOCK DIAGRAM**



**PIN CONNECTIONS**



**FIGURE 1 — TYPICAL APPLICATION IN A SCANNER RECEIVER**



We will occasionally include an extra page or two like this one which will be called a "Supplementary Page". There's never an extra charge for it, and it's one way we can express our thanks to for bearing with us in this early stage of "WORLD SCANNER REPORT's" printing history. Thank you!

### DISCUSSION OF THE NFM CHIP COMMON TO MOST SCANNERS

"Professor Peabody's" article this month centers around an integrated circuit that's used in most every scanner on the market nowadays and in a lot of other radios which have narrow band FM. The complete and proper name of this chip is...are you ready:

**NFM-Osc-Mixer-Limiter-Discriminator-Filter-Squelch-Scan-Mute**

Gosh, what a mouthful! For the sake of simplicity, bear with me as I subsequently refer to it as simply the "NFM chip". There are a number of versions of the NFM chip, but all do practically the same thing. These chips come in 16, 18 and 20 pin configurations, and all have virtually the same functions. We will disregard the minor differences from one variety to the next because they're not important. What is important is that an NFM chip is used in every scanner on the market today. We may as well understand the logic and functioning of this chip because some of our past, present and future modifications will be done to or around it. You should know what to look for and be able to recognize it where ever it resides in your scanner. Various versions of the NFM chip are listed in "Professor Peabody's" article in the Table on page 3. A number of popular scanners with the chips' circuit symbols and pin numbers are also given in that Table.

The NFM chip is practically an entire receiver on a chip, lacking only a front end RF amplifier, and an audio power amplifier in the simplest concept. This very chip and only a handful of other parts can be assembled into a full fledged, operable FM receiver, which is actually done in some of the very cheap import rigs. For the most part, though, the NFM chip is only a small cog on a large wheel in our scanners. Without it, your scanner could very well be twice it's present size at three times the cost!

On page 6, I have reprinted two Motorola Data Sheets for three of the most common versions of the NFM chip, and the three shown there will cover the actual chip used in most all scanners today. Referring to the Table on page 3, the common TK-10420 used in the PRO-2004/5/6 is actually the same thing as the MC-3357 on page 6. The TK-10421M-2 used in the BC-200/205XLT is the same thing as the 20-pin version of the MC-3359. The NJM-3359D-A as used in most other Uniden Bearcat scanners is typified by the 18-pin version of the MC-3359. And the MC-3361 (not shown) is pretty much the same as the MC-3357. So regardless of which scanner you have, just find and count the pins on your NFM chip, and one of the two Data Sheets on page 6 will be an exact or very close match.

Next is a technical description of how the NFM chip works in the PRO-2004/5/6 scanners, but if you have a different scanner, don't despair; it will work the same way as I describe for the PRO-200x; only the pin numbers will change, and you can keep track of that by referring to the appropriate Data Sheet for your NFM chip.

A 2nd I.F. signal of 10.7 MHz is injected into pin 16 where it is fed to the NFM chip's internal Mixer. An external crystal at 10.245 MHz drives Pins 1 & 2, the oscillator, the signal of which is also fed to the internal Mixer. The subtractive component of the Mixer signal, 455 KHz (10.700 MHz - 10.245 MHz = 455 KHz) is fed out of the chip via pin 3 to an external bandpass filter, sometimes known as the I.F. filter. It is this filter which sets the ultimate selectivity of the receiver's NFM and AM sections. (We will work with this 455 KHz I.F. filter in coming mods, so take note!) The output of the I.F. filter is fed back into the NFM chip at pin 5 to a very high gain Limiter Amplifier where weak and strong signals alike are amplified to maximum and clipped of all residual AM signal and noise leaving only an FM signal. The Limiter then drives the internal Discriminator (detector) which is balanced by an external tuning coil at pin 8. The output of the Discriminator feeds an internal audio preamplifier and outputs weak audio to pin 9. The audio is routed out to the audio section of the receiver for further processing and amplification, but a portion of it is sampled at pin 9 and passed through an external filter network and then back into the NFM chip at pin 10 where the sampled audio is further filtered and stripped of extraneous noise and then outputted to pin 11 for input to an external Noise Detector. The Noise Detector compares the raw signal from pin 11 with the signal from pin 9 and if they are the same (no RF signals coming in), it does nothing. If the signals are different, then voice or data are present, and a logic signal is sent back into pin 12 to operate the internal Squelch generator. A Squelch Logic signal comes out of the Squelch generator at pin 13 and on to the scanner's CPU to tell it whether to "Scan" or "Lock up". When the scanner is "scanning", an internal electronic switch shunts pin 14 to pin 15 where there is an external ground. This ground "mutes" or silences the receiver when signals are not present. When signals are present, the ground is internally switched off of pin 14 to allow the receiver to reproduce the audio. Thus, "mute" and "Squelch" are not the same thing, although they work together.

The highlights of the NFM chip are the 455 KHz I.F. output at pin 3; filtered 455 KHz input to pin 5; discriminator tuner at pin 8; low level audio output at pin 9; Squelch generation/detection at pins 10, 11, & 12; Squelch logic output at pin 13 (low or high) for the CPU; and Mute generation at pin 14. Take note of this: when SQUELCH is set; the output at pin 13 will be low at about 0 volts; when the SQUELCH breaks (signals in), the output at pin 13 will be high at +4 to +8 volts, depending on the scanner. We will use this Squelch Logic for several of our modifications. Also note this: when SQUELCH is set, the Mute signal at pin 14 will be low at about 0 volts; when SQUELCH breaks, Mute pin 14 goes high to around +4 to +8 volts. We will use this "Mute Logic" in some of our modifications, starting with "Professor Peabody's" Squelch Switch in this issue!

And so you see, the NFM chip is a most important one. It contains the equivalent of what would have been an entire circuit board of a few years ago. Now, it and its supporting external circuitry occupy a space of maybe two square inches or so. Acquaint yourself with the specific version of this chip that's used in your scanner. The best starting point before removing the case of your scanner is the Service Manual for your unit.





# SQUELCH SWITCH MODIFICATION

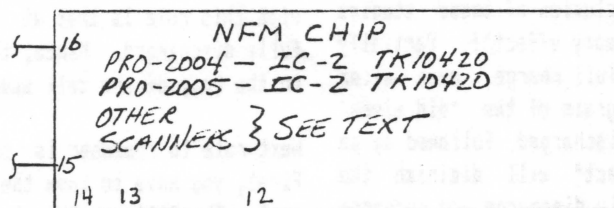
NOTE: IN PRO-2004,  
R-148 IS EASILY  
CLIPPED.

IN PRO-2005, IT MAY  
BE EASIER TO CLIP  
PIN 14 OF IC-2 AND  
SOLDER TWO WIRES  
TO THE CUT  
ENDS.

CUT THIS  
RESISTOR LEAD  
AS SHOWN

ADD TWO  
WIRES

OPTIONAL  
SQUELCH MOD-4  
100K-200K  
TRIM POT  
LEAVE OUT IF  
DESIRED. NOT  
NECESSARY



R-152 (33K) PRO-2005  
R-148 (47K) PRO-2004  
SEE TEXT FOR OTHER SCANNERS

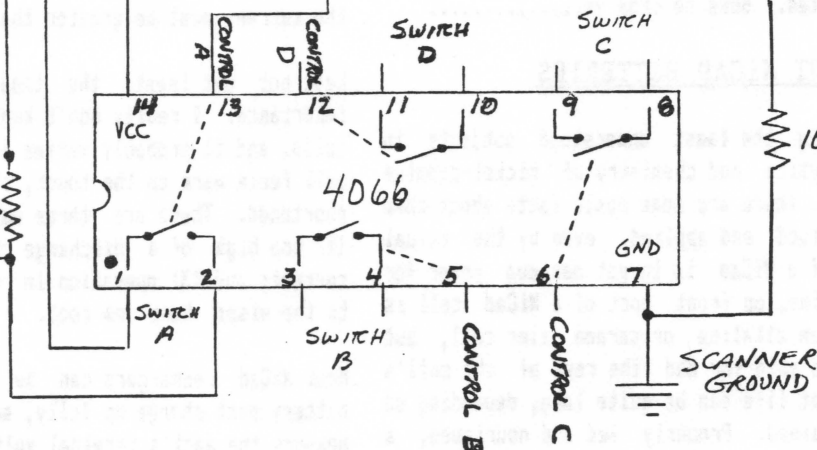
PRO-2004/5  
OUTPUT  
OF IC-8

TO CPU "MUTE"  
PIN AS FOLLOWS:

PRO-2004 - IC 3  
PIN 12 OR 13  
OR CN-504  
GRAY WIRE PIN 8

PRO-2005  
IC 3  
PIN 12 OR 13  
OR  
CN 3 PIN 12  
YELLOW WIRE

OTHER SCANNERS  
SEE TEXT



## PARTS LIST

1EA 74HC4066 OR CD-4066  
1EA 10K RESISTOR  
1EA 100K RESISTOR  
MISC HOOK UP WIRE  
MISC PERF BOARD

## NOTE:

PINS 3, 4, 5, 6, 8, 9,  
10, 11, 12 ARE  
NOT USED

"THE WORLD SCANNER REPORT" (c) 1991

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03/26/91

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Scanning? Radio? Radio? Listening? Radio?

Career/Profession

Occupation:

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List the make & model of any computer equipment you own/operate:

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Other Available Literature

SCANNER MOD HND BK, Vol-1: \$17.95 + \$3.00 S&H\*

SCANNER MOD HND BK, Vol-2: \$17.95 + \$3.00 S&H\*

\*Canada \$4 S&H; Other Foreign \$5 S&H; Air Mail extra

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need other information or a personal reply!

of NiCad cells on lengthy space missions where full recharges might be few and far between. The conclusion of these studies failed to disclose any evidence of a "memory effect"! Partially charged and discharged cells accepted full charge, even after lengthy periods. This goes against the grain of the "old wives' tale" that if NiCad cells are not fully discharged followed by an immediate full recharge, a "memory effect" will diminish the cell's capability. The "cure" was to fully discharge and recharge it several times to erase the "memory effect". The studies failed to show this effect. The report went on to confirm that heat and over-charging were the greatest single factors that could damage a NiCad cell. I cannot remember where I read this article now and would like to hear from any readers who may have knowledge of this new finding. By the way, belief in this "old wives' tale" does not detract from anyone's credibility since engineers around the world and even NASA apparently subscribed to the NiCad "memory effect". For whatever it is worth, I did, too, and even thought I had seen proof that it existed. Goes to show ya.....

### MORE ABOUT NiCAD BATTERIES

The NiCad battery is among the least understood subjects in electronics. While the physics and chemistry of nickel-cadmium cells can be rather "hairy", there are some basic facts about them that can be readily understood and applied, even by the casual hobbyist. The main idea of a NiCad is to get maximum power for the least cost. The one-time, up front cost of a NiCad cell is rather high, compared to an alkaline or carbon zinc cell, but after a few recharges, it's paid for and the rest of the cell's life is basically free. That life can be quite long, depending on how they're used and maintained. Properly fed and nourished, a NiCad cell is good for hundreds or even thousands of recharges!

There are three important factors on which to focus for maximum cell life: maximum charging voltage; maximum charge current and temperature. First, forget the "1.2v" that's imprinted on every NiCad cell. That's only a nominal value. The maximum full charge of a NiCad cell is 1.44 volts, period. If the terminal voltage is higher than that, it's overcharged and its life is shortened. If the voltage is under 1.4 volts, then it's not fully charged. The first rule of thumb, allowing for a bit of measurement error is to

never allow a NiCad cell to reach more than 1.40 volts. Along with this rule is that at 1.0 volt, the cell is considered to be fully discharged. Hence, the median 1.2 volt label usually found on the body of the cell somewhere.

Next rule to remember is the maximum charge current of the cell. First, you have to know the milliampere/hour (ma/h) rating of the cell. The "AA" cell is typically rated at 600 ma/h, (C), which means that it is capable of generating 600 milliamps for one hour while maintaining its specified voltage range, 1.4 to 1 volt. The maximum fast charge current is generally specified to be  $\frac{1}{3}$  of the cell's (C) rating, (200-ma for the "AA" cell), but even at this maximum, excess heat can be generated within the cell which can shorten the its life. The recommended trickle charge current is about  $\frac{1}{10}$  the ma/h rating, or about 60-ma for the typical "AA" cell. These charge current limits are referred to as the C/3 and C/10 ratings, respectively. To safely and fully charge a cell, the current must be greater than C/10 and less than C/3.

Last but not least, the temperature of the cell is of vital importance. I really don't know the absolute temp limit for NiCad cells, and it probably varies from one type to another, but if the cell feels warm to the touch, it is too hot and its life is being shortened. There are three ways a NiCad cell can get too warm: (1) too high of a discharge current; (2) too high of a charge current; and (3) operation in too warm of an environment. Words to the wise: Keep 'em cool.

Most NiCad rechargers can be checked: first, let a cell or battery pack charge up fully, say for 14 hours or longer, and measure the pack's terminal voltage. The measured voltage should not exceed 1.40-1.44 volts times the number of cells in the pack. A 6-cell NiCad pack should not measure more than 8.40 to 8.60 volts when fully recharged. If more or less than that range, the recharger is defective or not properly designed for the pack. Next, start with a discharged pack, and insert a milliammeter in series with one of the two leads between the recharger and the pack. The charge current should be greater than one-tenth and less than one-third the ma/h rating of the pack. Then, after the pack is fully recharged, the trickle charge should be pretty close to one-tenth the ma/h rating of the pack. More later; 73/BC

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